PCT WORLD INTELLECTUAL PROPERTY ORGANIZATION
International Bureau

INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification 6: G08B 21/00	A1	(11) International Publication Number: WO 98/22920
		(43) International Publication Date: 28 May 1998 (28.05.98)

(21) International Application Number: PCT/US97/17345

(22) International Filing Date: 26 September 1997 (26.09.97)

(30) Priority Data:
08/755,271 22 November 1996 (22.11.96) US

(71) Applicant: BREED AUTOMOTIVE TECHNOLOGY, INC. [US/US]; P.O. Box 33050, Lakeland, FL 33807-3050 (US).

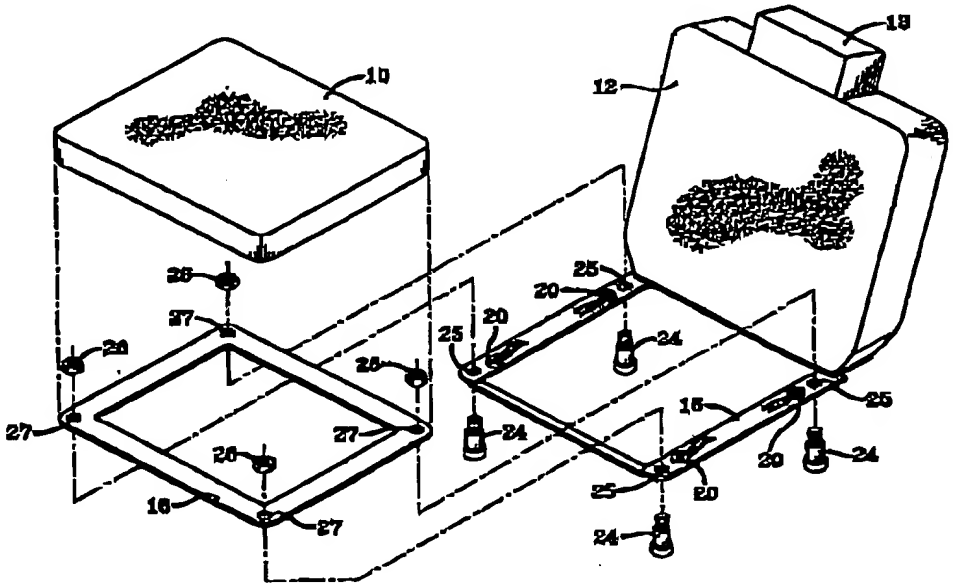
(72) Inventor: MAHON, Geoffrey, Lawrence; 221 Circle Avenue, Ridewood, NJ 07450 (US).

(74) Agent: DRAYER, Lonnie, R.; Breed Automotive Technology, Inc., P.O. Box 33050, Lakeland, FL 33807-3050 (US).

(81) Designated States: CA, DE, GB, JP, KR, European patent (AT, BE, CH, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE).

Published
With international search report.

(54) Title: SEAT OCCUPANT SENSING SYSTEM



(57) Abstract

A seat occupant sensing system has at least one sensor (20) interposed between a rigid seat support member (16) and a rigid seat pan member (18) such that the weight supported by the seat pan member is transferred from the seat pan member to the seat support member via said at least one sensor which senses the magnitude of the weight transferred therethrough. A device, such as a microprocessor, processes a signal from the sensor(s) to determine the weight that the rigid seat pan member is bearing. The signal processing device may control the activation and operation of a safety device such as an airbag or seat belt pretensioner as a function of the presence of and weight of a seat occupant.

FOR THE PURPOSES OF INFORMATION ONLY

Codes used to identify States party to the PCT on the front pages of pamphlets publishing international applications under the PCT.

AL	Albania	ES	Spain	LS	Lesotho	SI	Slovenia
AM	Armenia	FI	Finland	LT	Lithuania	SK	Slovakia
AT	Austria	FR	France	LU	Luxembourg	SN	Senegal
AU	Australia	GA	Gabon	LV	Latvia	SZ	Swaziland
AZ	Azerbaijan	GB	United Kingdom	MC	Monaco	TD	Chad
BA	Bosnia and Herzegowina	GE	Georgia	MD	Republic of Moldova	TG	Togo
BB	Barbados	GH	Ghana	MG	Madagascar	TJ	Tajikistan
BE	Belgium	GN	Guinea	MK	The former Yugoslav Republic of Macedonia	TM	Turkmenistan
BF	Burkina Faso	GR	Greece			TR	Turkey
BG	Bulgaria	HU	Hungary	ML	Mali	TT	Trinidad and Tobago
BJ	Benin	IE	Ireland	MN	Mongolia	UA	Ukraine
BR	Brazil	IL	Israel	MR	Mauritania	UG	Uganda
BY	Belarus	IS	Iceland	MW	Malawi	US	United States of America
CA	Canada	IT	Italy	MX	Mexico	UZ	Uzbekistan
CF	Central African Republic	JP	Japan	NE	Niger	VN	Viet Nam
CG	Congo	KE	Kenya	NL	Netherlands	YU	Yugoslavia
CH	Switzerland	KG	Kyrgyzstan	NO	Norway	ZW	Zimbabwe
CI	Côte d'Ivoire	KP	Democratic People's Republic of Korea	NZ	New Zealand		
CM	Cameroon			PL	Poland		
CN	China	KR	Republic of Korea	PT	Portugal		
CU	Cuba	KZ	Kazakstan	RO	Romania		
CZ	Czech Republic	LC	Saint Lucia	RU	Russian Federation		
DE	Germany	LI	Liechtenstein	SD	Sudan		
DK	Denmark	LK	Sri Lanka	SE	Sweden		
EE	Estonia	LR	Liberia	SG	Singapore		

SEAT OCCUPANT SENSING SYSTEM

The present invention relates to an apparatus for sensing the presence and weight of an occupant of a vehicle seat.

Many vehicles are equipped with safety devices such as airbags, seat belt pretensioners and so forth to protect persons occupying various seats in the vehicle. If a seat is unoccupied or is occupied by a person of a particular size, it may not be necessary to activate a safety device associated with that seat. Furthermore, if a seat is occupied by a person of a particular size the manner in which a safety device is employed may be varied accordingly. One indicator of the size of a seat occupant is his or her weight. In the case of an infant, the combined weight of the infant and an infant safety seat is useful as an indicator of occupant size.

BRIEF DESCRIPTION OF THE DRAWINGS

The invention may take physical form in certain parts and arrangement of parts, a preferred embodiment of which will be described in detail in this description and illustrated in the accompanying drawings which form a part hereof and wherein:

Fig. 1 is an exploded view of a vehicle seat equipped with an occupant sensing apparatus in accordance with the present invention;

Fig. 2 is a front elevation view of a vehicle seat equipped with an occupant sensing apparatus in accordance with the present invention;

Fig. 3 is a side elevation view of a vehicle seat equipped with an occupant sensing apparatus in accordance with the present invention;

Fig. 4 is a top view of a vehicle seat equipped with an occupant sensing apparatus in accordance with the present invention;

Fig. 5 is an enlarged fragmentary view of a sensor located between rigid components of a vehicle seat equipped with an occupant sensing apparatus in accordance with the present invention; and

Fig. 6 is a schematic view of an occupant sensing apparatus in accordance with the present invention.

DETAILED DESCRIPTION OF THE INVENTION

Referring first to Figs. 1 through 4 there are shown exploded, front elevation, side elevation and top view, respectively, of a vehicle seat equipped with an occupant sensing apparatus in accordance with the present invention. Of course it is understood that the design of various structural components of a vehicle seat can vary from one make and model of vehicle to another, with the vehicle seat shown being merely exemplary of a vehicle seat that may be employed in the practice of the present invention. The present invention does, however, apply to seats in general and may be employed not only with vehicle seats but also any seat where it is desired to ascertain whether or not the seat is occupied and the weight of a seat occupant.

A vehicle seat has a seat cushion 10 and a seat back 12. The seat back may have a head rest 13 associated therewith. The seat back may be pivotally attached to the remainder of the seat, as best seen in Fig. 3. The seat cushion 10 and seat back 12 are normally padded, for example with foam rubber, and may contain springs to provide comfort for a seat occupant. The seat has legs 14 which extend between the floor of the vehicle and a rigid seat support member 16, sometimes referred to as the seat frame. The rigid seat support member may be unitary, as shown in Fig. 1, with a cross member extending between two side rails, or the side rails may be only be joined to one another by the seat back and maintained parallel to one another by fastening the seat legs to the floor of the vehicle.

A rigid seat pan member 18 supports the seat cushion 10, which is adapted to be secured thereto by having bottom side that is contoured to be complementary to the rigid seat pan member. The rigid seat pan member has a generally rectangular shape which may be adapted to the design of a particular seat cushion and seat frame. As shown in Fig. 1 the rigid seat pan member is substantially a flat frame, however, in some seat designs the perimeter of the rigid seat pan member may be bent to form peripheral walls which may, or may not, have a second horizontal portion associated therewith.

The rigid seat support member 16 and the rigid seat pan member 18 are fastened to one another in a spaced apart, vertically juxtaposed relationship, as best shown in Fig. 5. In this example the means for fastening the rigid seat support member and the rigid seat pan member to one another are a plurality of shoulder bolts 24 and nuts 26. The shoulder bolts extend through openings 25 in the rigid seat support member 16 and openings 27 in the rigid seat pan member 18.

At least one sensor 20 is interposed between the rigid seat support member 16 and the rigid seat pan member 18 such that all of the force transferred from the rigid seat pan member to the rigid seat support member in a direction perpendicular to a surface of the rigid seat support member which is proximal to the rigid seat pan member is transferred via said at least one sensor. Preferably a sensor is located in the vicinity of each corner of the generally rectangular rigid seat pan member. The sensor 20 senses the magnitude of the force transferred therethrough and may be for example a strain gauge, a load cell or a

variable resistance pressure sensor. A working prototype of a vehicle seat equipped with an occupant sensing apparatus in accordance with the present invention employed as four sensors 20 which were Model 14 compression only subminiature load cells purchased from Sensotec, Inc. of 1200 Chesapeke Avenue, Columbus, Ohio U.S.A. These sensors had a range of either 45.4 kilograms (100 pounds) or 113.5 kilograms (250 pounds) and a seat could be equipped with only one size sensor or a combination of sizes. For example, 113.5 kilogram sensors could be used towards the front of the seat and 45.4 kilogram sensors could be used towards the rear of the seat. The height of these sensors is 3.8 millimeters (0.15 inch). If the surface of the rigid seat pan member which is proximal to the sensor is not substantially flat, it is desirable with these commercially available sensors to place a shim of some sort between the sensor and the rigid seat pan member to improve the transfer of forces from the rigid seat pan member to the sensor. Each sensor 20 has a plurality of electrical leads 21,22 extending therefrom for communicating with a device which processes the signal from each sensor to determine the weight that the rigid seat pan is bearing.

As best shown in Fig. 5 the nuts 26 are spaced apart from the rigid seat pan member a small distance D such that the means for fastening does not impart any preloading to the at least one sensor. In a preferred embodiment the only preloading on the a sensor is imparted thereon by the rigid seat pan member 18 and the seat cushion 10. However, in some seat designs the seat back 12 may also impart some preloading on the at least one sensor.

Referring next to Fig. 6 there is shown a schematic view of an occupant sensing apparatus in accordance with the present invention. A signal from at least one sensor is passed through an amplifier to a device, such as a microprocessor which processes the signal, or signals, to determine the weight that the rigid seat pan member is bearing. Algorithms to translate a signal to a weight are well known and are used for example in electronic bathroom scales. The algorithm must take into account the weight of the seat cushion and the rigid seat pan member in determining the weight of the seat occupant. Of course if the weight of the seat occupant is determined to be zero, the seat is unoccupied.

There is a need in the field of inflatable vehicle occupant restraints, such as airbags, to determine if the occupant of the front passenger seat of a motor vehicle equipped with a front passenger side airbag is an infant in an infant seat or a small child weighing less than a preselected amount. The device, such as a microprocessor which determines the weight that the rigid seat pan is bearing is preferably a controller which controls the activation of at least one safety device for an occupant of the seat based upon said weight. The controller controls, for example, the activation of an inflatable vehicle occupant restraint or a seat belt pretensioner. Additionally the controller may control the manner in which an activated safety device operates, for example controlling the speed at which an airbag is inflated or the amount of seat belt slack which is to be taken up by a pretensioner. Thus, the seat occupant sensing system disclosed herein may determine the presence or absence of an object or person on a seat cushion, and

the weight of the person or object on a seat cushion and based upon those determinations may activate one or more safety devices, and/or the manner in which an activated safety device should operate.

5

CLAIMS:

1. A seat occupant sensing system comprising:

(a) a seat having a rigid seat support member (16) and a rigid seat pan member (18) fastened to one another in a spaced apart, vertically juxtaposed relationship;

(b) at least one sensor (20) interposed between the rigid seat support member and the rigid seat pan member such that all of the force transferred from the rigid seat pan member to the rigid seat support member in a direction perpendicular to a surface of the rigid seat support member which is proximal to the rigid seat pan member is transferred via said at least one sensor which senses the magnitude of the force transferred therethrough; and

(c) a device which processes a signal from said at least one sensor to determine the weight that the rigid seat pan member is bearing.

2. A seat occupant sensing system according to claim 1 wherein the rigid seat pan member (18) has a generally rectangular shape and a sensor (20) is located in the vicinity of each corner of the rigid seat pan member.

3. A seat occupant sensing system according to claim 1 wherein said at least one sensor (20) is a strain gauge.

4. A seat occupant sensing system according to claim 2 wherein said sensors (20) are strain gauges.

5. A seat occupant sensing system according to claim 1 wherein said at least one sensor (20) is a load cell.

6. A seat occupant sensing system according to claim 2 wherein said sensors (20) are load cells.

7. A seat occupant sensing system according to claim 1 wherein said at least one sensor (20) is a variable resistance pressure sensor.

8. A seat occupant sensing system according to claim 2 wherein said sensors (20) are variable resistance pressure sensors.

9. A seat occupant sensing system according to claim 1 wherein the rigid seat support member (16) and a rigid seat pan member (18) are fastened to one another by a fastening means which does not impart any preloading to the at least one sensor (20).

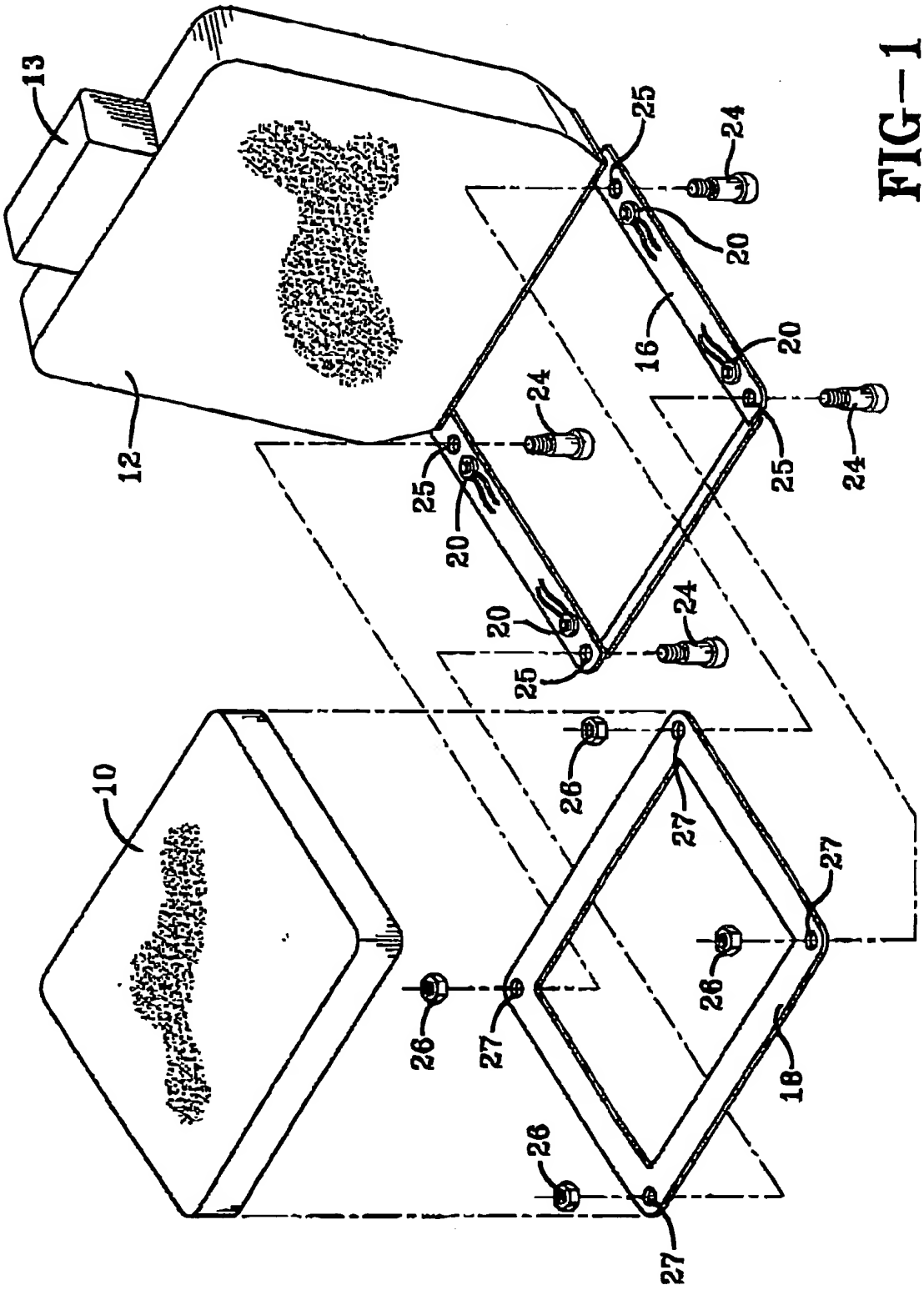


FIG-1

2/3

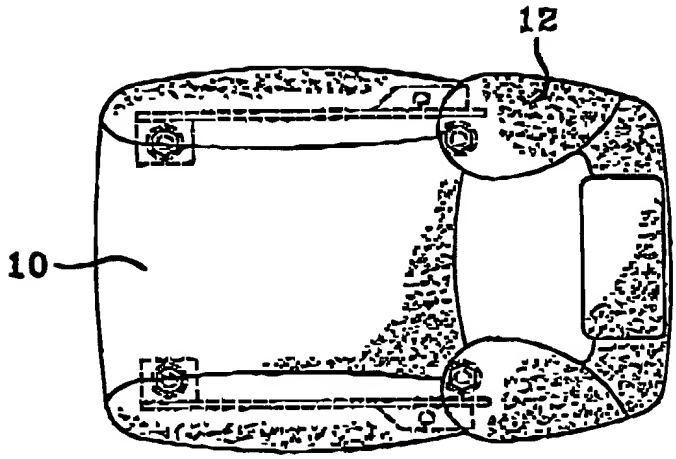


FIG-4

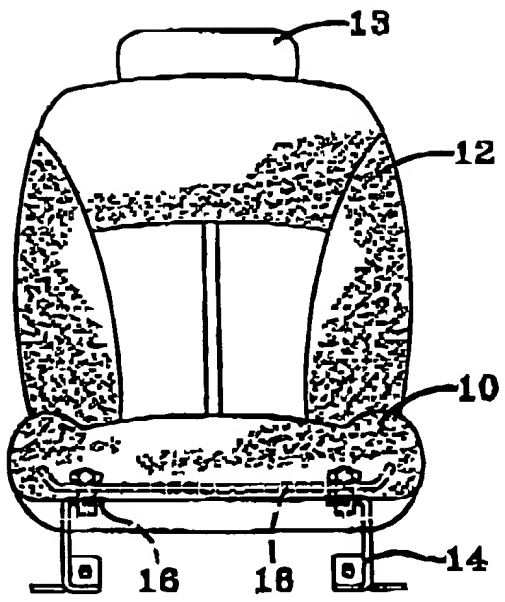


FIG-2

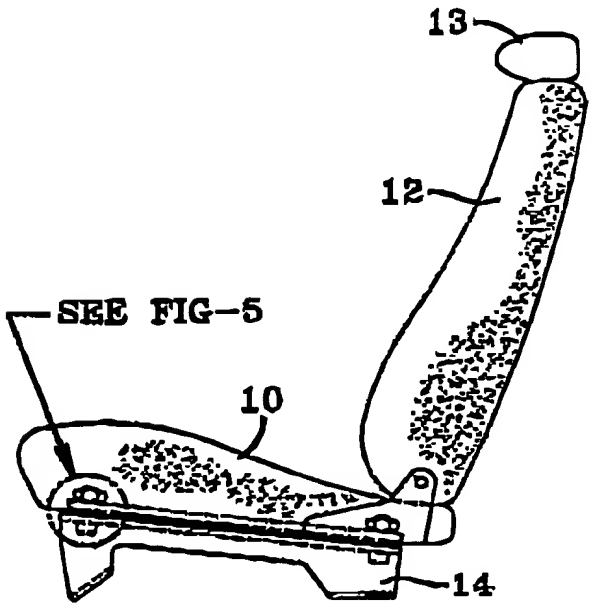


FIG-3

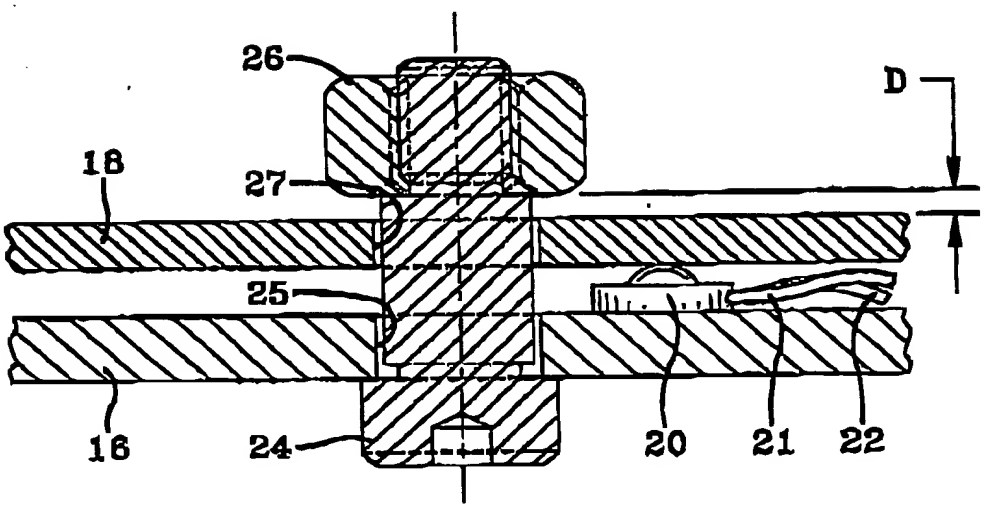

26
D
18
27
25
16
24
20
21
22

FIG-5

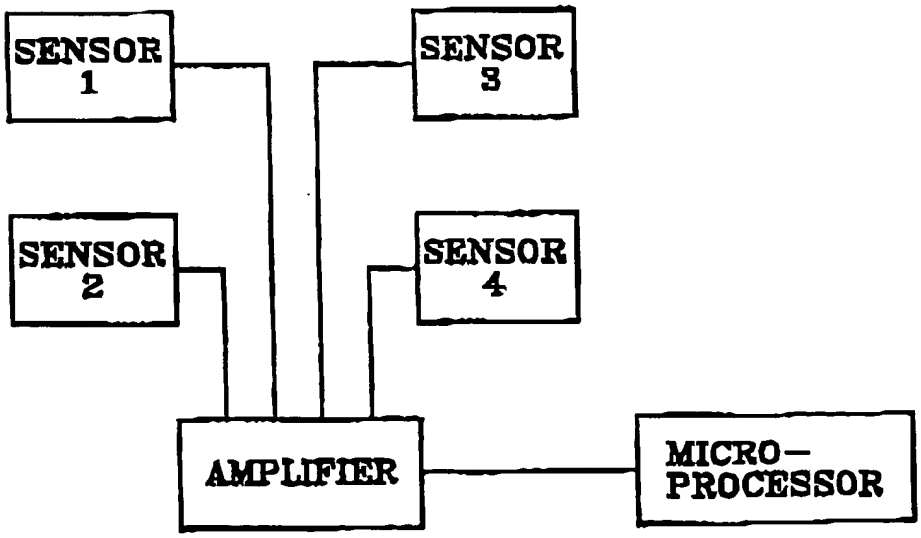

SENSOR 1
SENSOR 3
SENSOR 2
SENSOR 4
AMPLIFIER
MICRO-PROCESSOR

FIG-6

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US97/17345

A. CLASSIFICATION OF SUBJECT MATTER

IPC(6) :G08B 21/00
US CL :340/667; 180/273; 280/730.1; 200/85A
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

U.S. : 340/667; 180/273; 280/730.1, 735, 807; 200/85A

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

None

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

None

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 5,502,284 A (MEILLER ET AL.) 26 March 1996, entire document.	1-9

☐ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

*	Special categories of cited documents:	"T"	later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"A"	document defining the general state of the art which is not considered to be of particular relevance	"X"	document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"E"	earlier document published on or after the international filing date	"Y"	document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"L"	document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)	"&"	document member of the same patent family
"O"	document referring to an oral disclosure, use, exhibition or other means		
"P"	document published prior to the international filing date but later than the priority date claimed		

Date of the actual completion of the international search 11 DECEMBER 1997	Date of mailing of the international search report 24 FEB 1998
Name and mailing address of the ISA/US Commissioner of Patents and Trademarks Box PCT Washington, D.C. 20231 Facsimile No. (703) 305-3230	Authorized officer Glen R. Swann III Telephone No. (703) 305-4384

Form PCT/ISA/210 (second sheet)(July 1992)*